NCEM Safety Controls Form

Researcher Name_____

Proposal #_____

Proposal Title_____

A. Work Authorization

I certify and acknowledge that I am responsible for my safety and for the safety of others around me.

I have discussed this Safety Controls Form with the NCEM staff member who is my Work Lead.

I understand that this general authorization to work is contingent upon conforming to the controls described in the following pages, including training, equipment- and location-specific orientations and authorizations, and safety procedures.

LBNL Work Lead Signature/Date _____

Signature authorizes work subject to specified controls

Researcher Signature/Date _____

Signature confirms understanding of conditional authorization per above statement

NCEM Safety Controls Form

Instructions to Researchers: *Complete this form, including Appendices that apply to your work. Bring it to John Turner to review. You may NOT begin work until this form, appropriate Appendices, and specific hands-on training requirements have been completed, discussed with your NCEM Work Lead, and signed.*

B. Work Description, Locations and Equipment Used

Indicate by checking below the type of work that you will be performing, and complete the appropriate Appendix as indicated.

- **X** Electron Microscopy – Complete **Appendix A *(Mandatory)*** and attach signed Driver's Licenses
- □ Sample Preparation Dry Lab (e.g., milling, dimpling, polishing) – Complete **Appendix B**
- □ Sample Preparation Wet Lab (e.g., wet-etch, chemical polishing, staining) – Complete **Appendix C**
- □ Photo Processing Dark Room – Complete **Appendix D**

C. General Safety Training and Controls

LBNL requires all employees and guests to be properly trained and work safely. Online courses (noted in blue text) are available at http://www.lbl.gov/ehs/training/courses_online/index.shtml and have been hyperlinked in this document.

Element of Work	Safety Training/Control	Completion verified by (name and date):
All work at NCEM *[MANDATORY]*	NCM0010 "Introduction to the Electron Microscope Center"	
	EHS0405 "General Employee Radiation Training"	
	SEC0203-Notice of External Monitor	
	DO NOT begin work until this Safety Control form has been reviewed and the work authorized.	

Appendix A *(Mandatory)*
Safety Analysis and Controls for Electron Microscope Use

1. **Locations and Equipment (check applicable)**. **Use of the microscopes is authorized by Driver's Licenses, NCEM Staff helps you obtain them. You must have a Driver's License for each microscope that you use. Attach completed and signed Driver's License to this Safety Controls Form.**

☐ 110 (CM200)	☐ 163 (3010 In-Situ)	☐ 169 (OAM)	☐ 72A-110 (TEAM 0.5)
☐ 112A (AEM)	☐ 165 (FIB)	☐ 171 (TITAN)	☐ 72B-110 (TEAM I)
☐ 118 (SPLEEM)	☐ 167 (LIBRA)	☐ 173 (TECHNAI)	☐ 62-114 (VG 501)

2. **Processes –** examples of typical processes include

Loading samples into electron microscopes; Manipulating electron microscope controls to view samples; Filling liquid nitrogen dewars from stock; Filling instrument dewars with liquid nitrogen from benchtop dewars

3. **Materials Used –** liquid nitrogen

4. **Safety Training and Controls**

Element of Work	Safety Training/Control	Completion verified by (name and date):
Using electron microscopes for imaging	Obtain a "Driver's License" prior to the use of each electron microscope. NCEM staff helps you obtain the appropriate documentation and training.	See the Driver's License for each microscope; attach copy
	Do not work on, adjust, test or otherwise manipulate power supplies. If there is a problem, contact NCEM staff.	[redacted]
Handling liquid nitrogen: filling desktop dewars from main storage, filling detectors from desktop dewars	Hands-on Orientation to Cryogen Use at NCEM	
	Wear long trousers and closed toe shoes whenever handling cryogenic liquids	[redacted]
	Wear safety glasses with side shields at all times when handling cryogenic liquids	
	Wear face shield over safety glasses when handling cryogenic liquids at pressure (e.g., filling desktop dewars from stock)	
	Wear loose-fitting, insulated gloves (e.g., "cryogloves") when hands can contact cryogenic temperatures	
	Use the stepstool when filling the detector dewars. Finds some means to fill the dewars to avoid lifting the LN source overhead.	

Appendix B
Safety Analysis and Controls for Sample Preparation – Dry Lab Use

1. Locations and Equipment

Obtain orientation/training and signed specific authorization for each piece of equipment used.

Location	Equipment	Orientation performed by (name and date):
159 (Ion Mill Lab)	PIPS (Precision Ion Polishing System)	
	Carbon Coater	
	Low Angle Ion Mill	
	Fischione Ion Mill	
	Fischione Plasma Cleaner	
	Fischione Nanomill 1040	
	Baltec RES 1010 Ion Mill	
	Buehler ECOMET Grinder/Polisher	
	Lindberg Blue-M oven (200C max)	
	Bransonic Ultrasonic Cleaner	
161 (Dimpling Lab)	Minimet 1000 Grinder/Polisher	
	D500i Dimpler	
	Gatan Dimpler	
	Minimet Polisher	
	Optical microscopes	
	FEI tabletop Scanning Electron Microscope	
	SST 650 Diamond Wheel Saw	
	SBT Sonicut 380 ultrasonic punch	
	Fisher Ultrasonic Cleaner	
109 Molecular Beam Epitaxy	MBE apparatus	
000 Microtome Room	Microtome	

2. Processes – examples of typical processes include

- Polishing/grinding using hand and automated (e.g., dimpler, flat plate) machines
- Milling using ion milling machines
- Examining samples using light and electron microscope
- Heating samples in an oven up to 200C
- Cleaning samples using an ultrasonic cleaner

3. Materials Used

- Compressed argon gas
- Compressed oxygenot applicablergon (25%/75% nominal) gas
- Polishing grits – silicon carbide, diamond (0.25μ minimum size)
- Oils (e.g., mineral) for making grit slurries
- Mild detergent (ultrasonic cleaner)
- Solvents in squeeze bottles (e.g., acetone, methanol, ethanol)
- Epoxy for mounting samples (premeasured packages)
- Metal solids as source material for the MBE. *No beryllium unless specifically authorized under a separate analysis and authorization*.

4. Safety Training and Controls

Element of Work	Safety Training/Control	Completion verified by (name and date):
Using equipment and supplies in the dry sample preparation laboratories for making samples	Obtain specific training and authorization for each piece of equipment.	See authorizing signature above (Section 1 of this Appendix)
	Do not change compressed gas cylinders. If a cylinder needs changing, contact an NCEM staff member.	[redacted]
	Do not modify or change configuration of any piece of equipment other than adjustments as covered in the On-the-Job training. Contact an NCEM staff member if other modifications are needed.	
	Wear safety glasses with side shields and other laboratory PPE as required by the postings in the laboratories.	
	Do not use any chemicals other than those listed in this Appendix in the dry labs. Other chemical use must be in the Wet Lab as specifically authorized using **Appendix C**.	
	Hearing protection is not required for use of the ultrasonic baths.	

Appendix C
Safety Analysis and Controls for Sample Preparation – Wet Lab Use

1. Locations and Equipment

Obtain orientation/training and signed specific authorization for each piece of equipment used.

Location	Equipment	Orientation performed by (name and date):
102 (Wet-Lab)	Fischione Jet-Polisher	
	Ultrasonic Cleaner	
	Hot-Plate	

2. Processes – examples of typical processes include

- Wet-etching (chemical polishing)
- Staining
- Semiconductor HF-dip

3. Materials Used

CHEMICALS IN 72-102

CABINET 1
Electrolyte Solutions
Perchloric Acid

CABINET 2- ACIDS
Acetic Acid Glacial
Citric Acid
Hydrochloric Acid
Lactic Acid
Nitric Acid
Phosphoric Acid
Succinic Acid
Sulfuric Acid

CABINET 3 - BASES
Ammonium Hydroxide
Calcium Chloride Dihydrate
Calcium Hydroxide

CABINET 4 - FLAMMABLES
Acetone
Acetonitrile
Ammonia
Amyl Accetate
Amyl Alcohol
2-Butoxyethanol
Butyl Alcohol
Cesium
Ethanol
Ethyl Acetate
Formvar
Heptane
Isocut Fluid
Methyl Alcohol
Methyl Isobutyl Ketone
N,N-Dimethylformamide
Petroleum Distillate
Petroleum Ether
Tetraethyl orthosilicate
Toluene
Trichloro-Trifluoroethane
2-Propanol (Isopropyl Alcohol)

Cesium Hydroxide
Chromium Oxide
Lithium Chloride
Sodium Chloride
Sodium Hydroxide

OXIDATORS
Aluminum Nitrate
Ammonium Persulfate
Barium Nitrate
Lanthanum Nitrate
Magnesium Perchlorate
Phosphorus Pentoxide
Potassium Nitrate
Sodium Nitrate

OTHER LIQUIDS
Chloroform
Collodion Solution
Desolve
Ethylene Glycol
Glycerol
Lead Citrate
Tetramethylammonium Hydroxide
Trichloroethylene

SOLIDS
Abietic Acid
Iodine, Sublimed
Potassium Hydroxide
Sodium Dichromate
Sodiuim Sulfate

CARCINOGEN CABINET
Araldite 502 – Epoxy Resin
Cadmium Carbonate
Cadmium Hydroxide
Chromium Trioxide
DDSA – Dodecenyl Succinic Anhydride
DER – 736 Epoxy Resin
DMP 3—Tri-Dimethylaminoethyl-Phenol
Formaldehyde
Lead Citrate, Trihydrate
Magnesium, Ribbon
Nickel Carbonate
Nonenyl Succinic Anhydride
Vinyl Cyclohexene Dioxide

REFRIGERATOR
Ethylene Diaminetetra Acetic Acid
Ethylene Glycol
Hydrogen Peroxide
Osmium Tetroxide
Ruthenium Tetroxide
Toluidine Blue O
Uranyl Acetate Dihydrate

TOXIC Nanohazards:

COLLOIDAL SILICA – SNOWTEX 0
COLLOIDAL SILICA – SNOWTEX 40
COLLOIDAL SILICA – SNOWTEX ZL

FULLERENE – C60
CARBON NANOTUBES

SILVER NANOPARTICLES In HEXANE

Additional chemicals stored in 72-159

Aluminum Hydroxide - Al(OH)(3), white powder; J. Matthey, Inc.
Aluminum Oxide, gamma - Al(2)O(3), white odorless powder; J. Matthey, Inc.
Aluminum Pellets, silvery colored metal, odorless.
Calcium Carbonate - CaCO(3), white powder; J. Matthey, Inc.
Calcium Chloride - CaCl(2) 2H(2)O, white granular; J.T. Baker, Inc.
Calcium Fluoride - CaF(2), colorless cubic crystals; J. Matthey, Inc.
Calcium titanium oxide – CaTiO(3), beige, odorless powder; Alfa Aesar
Cellulose Acetate Butyrate (CAB), Butyl content = 17%, while flakes; Kodak, Inc.
Cobalt (II) Carbonate - CoCO(3), red powder or rhombohedral crystals; J. Matthey, Inc.
Cupric Sulfate - CuSO(4)-5H(2)O, fine blue crystals; Bryant Lab.
Ferrous Chloride – (FeCl(2)-H(2)O Tetrahydrate, Dihydrate, Anhydrous, grey powder; Mallinckrodt
Gallium Arsenide, pieces – GaAs, shiny grey wafer or chips
HFC Duster 1,1,1,2 Tetrafluoroethane, metal canister
Lanthanum Carbonate - La(2)(CO(3))(3)8H(2)O, white crystalline powder.
Lead Shot – Pb, grey, round shots; J.T. Baker, Inc.
Lead Titanium Oxide - (PbTiO(3), white powder; J. Matthey, Inc.
Magnesium Hydroxide - Mg(OH)(2), white powder, odorless - J. Matthey, Inc.
Magnesium Oxide - MgO - 99.99%, white powder; J.Matthey, Inc.
Nickel (II) Chloride - NiCl(2) 6H(2)O, hexahydrate, anhydrous, green powder; Mallinckrodt
Sodium Chloride – NaCl -- Salt, rock salt, saline, table salt, white crystalline; J.T. Baker
Sodium Sulfite - Na(2)SO(3), white crystals; Mallinckrodt
Sodium Hydroxide – NaOH, white pellets
Tin, granular – Sn, silver/brown granules; J.T. Baker
Titanium Dioxide – TiO(2), white, ordorless powder; K. Lesker Co.
Titanium (III) Oxide – Ti(2)O(3), black, odorless powder; Alfa Aesar & K. Lesker
Zinc – ZN, solid grey shots; J.T. Baker

4. Safety Training and Controls

Element of Work	Safety Training/Control	Completion verified by (name and date):
All work in the Wet Lab	Obtain specific training and authorization for each piece of equipment.	See authorizing signature above (Section 1 of this Appendix)
Preparing samples in the wet lab 72-102 (not including uranium staining)	EHS0348 "Chemical Hygiene and Safety"	
	EHS0604 "Hazardous Waste Generator"	
	Hands-on orientation to the Wet Lab (conducted by Wet Lab Supervisor)	
	DO NOT work on weekends or holidays. Work only M-F, 0800-1800	[redacted]
	Leave one or both lab doors propped open with doorstops when working in the wet lab. This is to permit access in case of an accident.	
	Use properly functioning fume hood or other containment for any procedure that liberates hazardous particulate, vapor or mist	
	Obtain specific approval from the Sample Prep Laboratory Manager for use of perchloric acid. Only use perchloric acid in the perchloric acid hood (left hood in Room 102). Wash down the system after use as specified by the approved procedure.	
	Obtain specific approval from the Sample Prep Laboratory Manager for the use of hydrofluoric acid. Inspect the HF emergency kit to assure that it is complete and that the gel is not beyond its expiration date.	
	Dispose of any oxidizing acid into its own labeled waste bottle. Do not combine oxidizing acid waste with any other waste, even if you think it is compatible.	[redacted]
	Wear lab coat, closed toed shoes, safety eyewear (safety glasses with side shields, goggles, face shield as appropriate). Wear eye protection whenever you are in any of the sample preparation laboratories. Wear goggles when handling corrosives.	
	Wear gloves appropriate for the material being handled (consult glove selection guide)	
Performing uranium staining in the wet lab 72-102	Contact the Principal Investigator to be added to the Radiological Work Authorization	
	Obtain training as specified in the Radiological Work Authorization.	
	Perform radiation work only in properly posted areas	[redacted]
	Conform to ALL requirements in the Radiological Work Authorization	
	Report any concerns to the Radiological Control Technician assigned to your project	

Element of Work	Safety Training/Control	Completion verified by (name and date):
Using electrical equipment	EHS0260 "Basic Electrical Hazard Awareness" (for non-NCEM standard setups)	
	Do not work on, adjust, test or otherwise manipulate power supplies. If there is a problem, contact NCEM staff.	[redacted]
Synthesizing, investigating or otherwise working with engineered nanomaterials in a manner that could result in potential exposure or environmental release.	EHS0344 "Safe Handling of Engineered Nanoscale Particulate Matter"	
	Use disposable lab coats and other Personal Protective Equipment	[redacted]
	Assure that purchased or externally acquired engineered nanomaterials are entered into the Chemical Management System, and specifically identified as being engineered nanomaterials. Contact John Turner for assistance with the Chemical Management System.	
	Treat all engineered nanomaterial-containing waste, including wipes, as Hazardous Waste.	

Appendix D
Safety Analysis and Controls for Darkroom Use

1. Locations and Equipment

Obtain orientation/training and signed specific authorization for each piece of equipment used.

Location	Equipment	Orientation performed by (name and date):
113 Darkroom	Dryer	
	Processing Sinks	

2. Processes – examples of typical processes include

- Developing
- Fixing
- Rinsing
- Drying

3. Materials Used

- Developer
- Fixer
- Hypochlor
- Photoflow

4. Safety Training and Controls

Element of Work	Safety Training/Control	Completion verified by (name and date):
All work in the Darkroom	Obtain specific orientation and training (conducted by darkroom supervisor)	